

- Native vegetation will be planted along 4,000 linear feet of stream buffer through the ravine during the subsequent dormant period (late fall/early winter). Planting will not occur near the stream or stream buffer.

2.5.4 East Fork Wetland Overflow

2.5.4.1 *Preconstruction Activities; East Fork Wetland Overflow*

The total length of the project area is 455 feet of pipe, which extends from the wetland at the top of the canyon to the East Fork of Madsen Creek. Conventional construction equipment will be used to install the overflow pipe along the existing access road. The pipe will be laid on the ground surface over the steep slope between the access road and the East Fork of Madsen Creek (no heavy equipment will operate on these steep slopes). A helicopter and/or skyline will be used to construct an energy dissipater from boulders and woody debris at the pipe outfall.

- A preconstruction meeting will be held. Attendance will be required of the following: contractor or county crew leads; design team biologist, engineer, geologist; water quality monitoring crew. Others invited will include representatives of the following organizations: Corps of Engineers, Muckleshoot Indian Tribe, State Fish and Wildlife, Department of Ecology, county grading inspector, and Homeowners Association representative. The agenda will include: Introduction; Review of the project and its goals; Review of the water quality monitoring process; and work alert and shut down levels.
- The materials staging area will be established in an access road area leading from SE 164th just west of 162nd Ave SE in Fairwood, north of the East Fork of Madsen Creek. The staging area will be used to store stream gravel, LWD, boulders, catch basins, and pipe.
- Silt fences and rock access pads will be set up at the staging area. Establish an emergency stockpile at the staging area including: 40 straw bales, 5 rolls of plastic sheeting, 10 yards of clean pea gravel, 1 cfs pump, and 100 feet of hose.
- Water quality monitoring will continue throughout construction. Sampling will occur a minimum of once every two hours during construction near the East Fork of Madsen Creek. More readings may be taken if turbid water is observed leaving the isolated work area. Monitoring stations will include a control site upstream of the project area, a site located at the confluence of the northwest tributary and the mainstem, the outlet of the Madsen Creek sediment pond, and the outlet of Madsen Creek at the Cedar River.

2.5.4.2 *Construction Activities; East Fork Wetland Overflow*

- Pipe construction will involve the placement of 350 feet of 12-inch pipe along the maintenance road. Construction will take place over a 12 to 15 day period. The trench will be 5 feet wide with an average depth of 6 feet. The quantity of excavation is 400 cubic yards, with the same amount of fill; an estimated 120 yards of material will not

be reused in the trench. This material will be used at the BPA pond construction site. Machinery used to construct the facility will include excavators, dump trucks, and payloaders. The pipe will be placed on the surface topographically along the ravine slope, between the maintenance road and the stream.

- Construction of the pipe from the road to the stream will be achieved by welding HDPE pipe together. An excavator and cat will be use to launch the pipe over slope, guiding with cable, ropes, and hand tools. The downstream end will nest into a structure of log, boulder, and streambed gravel to diffuse the force of the flow from the pipe. Logs, boulders, and gravel will be placed by skyline or helicopter.
- Water quality will be monitored downstream for turbidity. If monitoring indicates that turbidity levels exceed state standards, the rate of reintroduction will be reduced to maintain those standards. When monitoring indicates that background turbidity levels are matched, the coffer dam will be completely removed.
- Native plants will be installed on the access road and disturbed areas in the winter of 2001-2002. Slopes and disturbed areas will be hydroseeded and mulched. Native plantings will be installed by hand to revegetate the ravine with conifers.

2.5.4.3 *Best Management Practices; East Fork Wetland Overflow*

All approved and necessary BMP's will be used during construction of the project. These are described below.

- All work on the East Fork Wetland Overflow will be carried out between June 1 and September 30.
- If inclement weather results in excessive sediment discharge, construction activities will be modified or suspended to control sediment.
- Silt fences will be in place before construction and clearing begins.
- Erosion control measures will be left in place until site conditions stabilize and water quality (turbidity) matches background levels.
- Disturbed areas of the access road and skyline spar will be seeded and mulched upon completion of construction.
- Exposed earth surfaces will be covered to minimize discharges of sediment-laden water during rainstorms.
- Hydroseeding and mulching of disturbed areas will occur within 30 days of final grading, and prior to September 30th.
- Native vegetation will be planted along 455 feet of pipe right-of-way that has been disturbed during the subsequent dormant period (late fall/early winter). Planting will not occur near the stream or stream buffer.

2.5.5 West Tributary Bypass Pipeline

The West Tributary bypass pipeline will collect surface flow from that portion of the Fairwood development lying within the West Tributary basin, and divert it into the detention pond proposed for the Northwest Tributary. The pipeline will be installed along 145th Avenue SE, and SE 162nd Street in the Fairwood area.

2.5.5.1 *Preconstruction Activities; West Tributary*

- A preconstruction meeting will be held. Attendance will be required of the following: contractor or county crew leads; design team biologist, engineer, geologist; water quality monitoring crew. Others invited will include representatives of the following organizations: Corps of Engineers, Muckleshoot Indian Tribe, State Fish and Wildlife, Department of Ecology, county grading inspector, and Homeowners Association representative. The agenda will include: Introduction; Review of the project and its goals; Review of the water quality monitoring process; and work alert and shut down levels.

2.5.5.2 *Construction Activities; West Tributary*

- Temporary erosion control facilities will be constructed around the drainage swale (which is anticipated to be dry during the summer). Emergency erosion and spill control stockpiles will be established, including: one 2-cfs pump with 300 feet of hose, 1,000 square yards of plastic sheeting, 10 cubic yards of pea gravel, and a package of oil-absorbent pads.
- Construction of the pipeline will start from the downstream end, near the pond site after May 1.
- The pipeline will be constructed in no greater than 500-foot segments, and backfilled as work is completed. The actual trench construction will involve the placement of 1,100 feet of 24- and 30-inch pipe along SE 165th Street, 145th Avenue SE, and SE 162nd Street. The trench will be five feet wide with an average depth of six feet. The estimated quantity of excavation is 1,200 cubic yards with the same amount of fill. The time to construct the project will be 40 working days. Machinery used to construct the facility will include excavators, dump trucks, payloaders, street sweepers, and paving machines.
- Temporary asphalt pavement will be placed over the excavated roadways at the end of each day.
- Development flow will be diverted from the west tributary basin only after completion of pipeline testing, the completion of the BPA pond, and streambed enhancement of the Northwest Tributary. The diversion will be done by placing a plug at the entrance to the West Tributary outfall. The new system will be tested by September 30th.

- Following construction, permanent pavement will be placed and the landscaped areas restored.

2.5.5.3 *Best Management Practices; West Tributary*

All approved and necessary BMP's will be used during construction of the project. These are described below.

- All pipeline work will be carried out between May 1 and September 30.
- If inclement weather results in excessive sediment discharge, construction activities will be modified or suspended to control sediment
- Silt fences will be in place before construction and clearing begins.
- Erosion control features will be left in place until site conditions stabilize and turbidity measurements match background levels.
- Exposed earth slopes will be covered during rain storm conditions.
- Temporary roadway patching will be placed at the end of each day over completed pipeline work. Landscaped areas will be restored prior to completion of the project and provided with erosion protection before the end of September.

2.5.6 BPA Detention and Water Quality Pond

A 10 acre-foot pond is proposed at the head of the Northwest Tributary. The pond will combine a water-quality wetland with stormwater detention. The pond will be constructed using heavy equipment.

2.5.6.1 *Preconstruction Activities; Detention Pond*

- A preconstruction meeting will be held. Attendance will be required of the following: contractor or county crew leads; design team biologist, engineer, geologist; water quality monitoring crew. Others invited will include representatives of the following organizations: Corps of Engineers, Muckleshoot Indian Tribe, State Fish and Wildlife, Department of Ecology, county grading inspector, and Homeowners Association representative. The agenda will include: Introduction; Review of the project and its goals; Review of the water quality monitoring process; and work alert and shut down levels.
- The boundaries of the clearing limits will be flagged for the project site. Flagging shall be maintained for the duration of construction.
- Temporary erosion control facilities will be established around the drainage swale (which is anticipated to be dry during the summer). Emergency and spill control stock piles will be established at the staging area, including: 50 straw bales, 1,000 square yards of plastic sheeting, 20 cubic yards of gravel, and 10 packages of chemical absorbent.

- Silt fence will be installed between the construction site and downstream areas.
- Prior to grading through existing drainage course, temporary flow bypass lines will be constructed.
- The swale (dry in the summer) will be blocked to divert any unseasonable surface flows into the bypass line.

2.5.6.2 Construction Activities; Detention Pond

- Vegetation within the access road footprint leading from 140th Street SE to the BPA right-of-way and pond construction area will be cleared. Vegetation removal will include Scot's broom and shrubby vegetation under the power lines. The access road will be graded and stabilized.
- Excavation will begin with track hoes, which will load dump trucks. Bull dozers, graders and compaction machinery will be used to grade the site. Approximately 12,000 cubic yards will be excavated and reused on site for construction of berms or placed in landscaped spoil areas on site. Construction will disturb 8 acres of the site. Construction is estimated to be 60 working days.
- The new flow-channel excavation into the new pond will then be finished. If any water is present because of an unseasonable flow, it will be diverted into the facility, and facility operation checked.
- Grading of the ponds and construction of the berms will then be completed, and the piping and outlet control structure built. The facility will then be vegetated and the bare slopes hydroseeded.
- The remaining temporary erosion measures will be removed the following summer. The outlet control will be adjusted as necessary. Maintenance of the site will continue indefinitely.
- Native plants will be installed on the access road and disturbed areas, and in the water quality retention pond in the winter of 2001-2002. Slopes and disturbed areas will be hydroseeded and mulched. Native plantings will be installed by hand.

2.5.6.3 Best Management Practices; Detention Pond

All approved and necessary BMP's will be used during construction of the project. These are described below.

- All work on the detention pond will be carried out between June 1 and September 30.
- If inclement weather results in excessive sediment discharge, construction activities will be modified or suspended to control sediment.
- Silt fences will be in place before construction and clearing begins.
- A stabilized construction entrance will be installed.

- Work in the swale will be accomplished when the swale is dry and dry weather conditions are forecasted for the area.
- Erosion control features will be left in place until site conditions stabilize and turbidity measurements match background levels.
- Exposed earth surfaces will be covered to minimize discharges of sediment-laden water during rainstorms.
- Hydroseeding and mulching of disturbed areas will occur within 30 days of final grading, and prior to September 30th.
- Placement of native vegetation throughout the construction site will occur in the fall.

2.6 Construction Schedule

Construction is scheduled to begin in late May and finish no later than September 30, 2001. The work duration's are noted in the various items of work above. No instream work will occur after mid-September, which coincides with the end of the typical construction window dictated by Washington Department of Fish and Wildlife for this area. Native vegetation will be planted during the dormant season, between the late fall of 2001 and the winter of 2002.

3.0 LOCAL DISTRIBUTION OF LISTED SPECIES

Although no reproducing bull trout populations are known in the Lake Washington drainage, some stray adults and sub-adults have been found foraging in the Cedar River (USFWS, 2000; Chan, personal communication). The mainstem of the Cedar River is considered an "intermittent use zone" for non-spawning bull trout, and areas draining to the mainstem (such as the Madsen Creek basin) are considered "areas influencing intermittent zones" (USFWS, 2000).

Chinook migrate, spawn, and rear in the Cedar River mainstem and a small percentage of rearing juveniles may remain in the freshwater system past the first summer. Some of these juveniles may occupy habitat in Madsen Creek near the mouth during warm-water periods, although this area is generally inaccessible during the summer and fall due to beaver dams, braided flow patterns, wiers, and dense in-channel vegetation (Adolfson Associates, Inc., 2000). Chinook have not been observed in Madsen Creek and are not expected above the immediate vicinity of the mouth (Fisher, personal communication, 2000; Adolfson Associates, Inc., 2000).

The local distributions of listed fish species (chinook salmon and bull trout) are shown on Figures 3b and 3c. Local distribution of bald eagle in the project vicinity is not shown as the closest known nest is approximately 4.5 miles away from the project area.

4.0 DEFINITION OF THE ACTION AREA

An "Action Area" is described herein to define the limits of potential impact from the proposed action. All potential direct and indirect effects are contained within this boundary. The Action Area is determined by analyzing all potential changes to the environment that may occur as a

result of the proposed action (NMFS and USFWS, 1998). Potential effects, which are discussed in greater detail in the Effects Section (Section 7.0), are listed below and their potential range of impact is shown on Figure 3.

4.1 Indirect Effects of the Action

In the long term, the proposed detention pond, channel modifications, and tree plantings will likely reduce the volatility of the Madsen Creek hydrograph, increase bank and channel stability, and reduce mass-wasting events in the Madsen Creek ravine (Bethel, personal communication 2000) (see Figures 3b and 3c, "Indirect Impacts (Potential for Restoration)"). These changes are likely to affect sediment loads in the Madsen Creek ravine near and downstream of all restoration areas, as well as flood frequency in the Madsen Creek/Cedar River floodplain below the ravine. Fish and eagle prey species abundance may also increase in Madsen Creek and in the Cedar River near the confluence of Madsen Creek once the stabilization measures take effect. The Action Area for aquatic and terrestrial habitat in Figures 3, 3b, and 3c therefore includes:

- 1) all steep slopes in Madsen Creek Ravine (above stream sections that will be modified and downstream of modified stream sections), and
- 2) the Madsen Creek/Cedar River floodplain as far as 500 feet upstream and two miles downstream of the Madsen Creek confluence (these limits are based on guidance provided by the US Army Corps of Engineers; Morris, personal communication, 1999).

4.2 Direct Effects of the Action

Although minimized to the extent practicable, construction of the proposed features will likely have short-term, negative effects on aquatic habitats and prey species populations the Madsen Creek stream channel (see Figures 3b and 3c, "Direct Impacts") and on avian habitats within 1 mile of the helicopter flightpaths (see Figure 3a, "Eagle Action Area"). These effects are described in the following sections.

4.2.1 Direct Effects to Aquatic Habitats

4.2.1.1 *Turbidity*

Based on soil types in the area, it is estimated that suspended particles make up 25 percent of the substrate that is mobilized from Madsen Creek (Bethel, 2000). Although some suspended particles may be held in the sediment pond along with unsuspended material, it is expected that the majority of this turbidity will continue moving downstream to the Cedar River. Turbidity is expected above five NTU in the lower channel of Madsen Creek, but is not expected in the Cedar River beyond the immediate confluence area; Cedar River flows are typically 175 times greater

than Madsen Creek flows during base-flow conditions³ (USGS, 2000; Bethel, 2000) (Figures 3b and 3c).

4.2.1.2 Sedimentation

Sedimentation, which sometimes accompanies turbidity, will likely increase in the sediment pond and in the stream channel between the sediment pond and in-stream work areas (Figure 3b and 3c). No sediment is expected to escape the sediment pond as work will not be conducted during high flows. Although some fine sand has escaped to the lower channel of Madsen Creek from the sediment pond in the past, it is thought that this failure occurs during high-flow events when turbulence or heavy loading in the pond allows smaller particles to escape into the low-flow channel outlet (Bethel, 2000). Since no work will be done during high-flow events (above five cfs), the sediment pond is expected to function properly during all in-water work (O'Neil, personal communication, 2000).

4.2.1.3 Temperatures in Madsen Creek

From the time that the detention pond is completed and put on line to the time the vegetative cover reaches maturity, a portion of the Madsen Creek flow input will be detained without full vegetative cover. Temperatures may increase in this detained water due to solar heating if periods of sun follow heavy rain events. During the summers following the installation of the detention pond, there may be periods of elevated temperatures after thunderstorms. This increase will likely be small and diluted by flows in the mainstem of Madsen Creek. No measurable change in temperature is expected in the Cedar River.

4.2.2 Direct Effects to Avian Habitats

Nearby avian habitat may be affected by noise during the project's construction. The Action Area for bald eagle includes the areas within which work will be done (particularly those areas where a helicopter will be employed), and all adjacent areas within one mile. This area is considered to be the disturbance zone for bald eagles for construction activities causing noise but excluding blasting, pile driving, or smoke (USFWS, 1999b). Therefore, the Action Area for bald eagles includes up to a one-mile radius around the project corridor (Figure 3a). Eagle avian prey species may be temporarily displaced from work areas during construction activity. The closest known bald eagle nest is 4.5 miles away on Mercer Island. No reduction in avian prey availability is anticipated in the foraging area associated with the Mercer Island nest or any other eagle nest.

³ This rationale is based upon flows in Madsen Creek and the Cedar River, as well as experience from work in a similar stream within the basin. Between 1989 and 1994, daily flow in the Cedar River and Madsen Creek averaged 185 cfs and 1.05 cfs, respectively, during the month of September (USGS, 2000), diluting turbidity in Madsen Creek approximately 175 times. Similar work in Maplewood Creek (downstream of Madsen Creek) produced no turbidity events above 5 NTUs in the Cedar River during WTD stream-channel modifications in 1998.

5.0 EXISTING CONDITIONS IN THE AQUATIC ACTION AREA

5.1 Madsen Creek

A detailed discussion of stream hydraulics, sediment transport, basin geology, stream morphology, and water quality baseline conditions for Madsen Creek can be found in the *Madsen Creek Pipeline Protection and Stream Restoration Predesign Report* (R. W. Beck, 1999). Although written for a previous project proposal, this report provides detailed information on habitat conditions in the basin as of 1999. This document, in conjunction with field observations collected by Adolfson staff in September, October, and November of 1999, provides the basis of information in this assessment.

The Madsen Creek ravine is relatively removed from surrounding development. The main stem of the stream flows from a stormwater detention pond in the Fairwood Community. Water passes through a 48-inch culvert and descends some 400 feet in elevation through a steep-walled ravine before reaching the Cedar River Valley floor. At the toe of the ravine slope, the stream enters a sediment pond constructed in 1974 on the south side of SR-169 (Figure 4). From the sediment pond, the stream flows through a low-flow channel that crosses under SR 169 and 149th Avenue SE. Below the 149th Avenue SE culvert, the low-flow channel passes through Regis Park and enters a wetland.

Because of the combination of increased flows from impervious surfaces and the regional geologic conditions, portions of Madsen Creek and its tributaries have experienced excessive channel erosion, bank failures, increased channel cutting and ravine formation, and excessive sediment deposition in the lowest elevation, low gradient reaches. These conditions have increased channel maintenance costs and the potential for lowland flooding, degraded fishery habitat, and contributed to failures in structures (e.g., a sanitary sewer pipeline) that have required emergency repairs. The stream degradation process has not been stabilized.

Efforts have been made to reduce erosion impacts to the lower basin through creation of the downstream sediment retention pond. Flood-control efforts have included periodic maintenance and installation of a high-flow bypass channel. Side effects of the high-flow channel have been observed, however, on numerous site visits during the fall of 1999. These effects include salmon stranding and mortality during channel dewatering and sediment and debris accumulation in the low-flow channel. The latter effect is assumed to be a consequence of the complete attenuation of peak-flows in the low-flow channel that, under normal conditions, maintain the channel depth and upstream access by periodically scouring out accumulated sediment and clearing blockages.

To describe Madsen Creek, the mainstem has been divided into three reaches. They are: 1) the *lower reach* that extends upstream across the Cedar River floodplain to the sediment pond, 2) the *middle reach* extending from the sediment pond upstream to the confluence with the East Fork, and 3) the *upper reach*, which extends upstream of the confluence with the East Fork to the 48-inch culvert near Fairwood Boulevard.

5.1.1 The Lower Reach

The lower reach of Madsen Creek divides (at the outlet of the sediment pond) into the low-flow channel and the high-flow bypass. The lower reach low-flow channel flows mostly through reconstructed channels of varying complexity and generally low habitat value (refer to Figure 4). Substrates are composed mainly of gravel and sand, and embeddedness appears to range from 50 to 100 percent. Morphology is dominated by runs. During rain events that last more than two or three days, excess water passes directly from the sediment pond to the Cedar River via an excavated high-flow bypass channel north of 149th Avenue SE, leaving only moderate flows in the low-flow channel (Figure 4). The entrance to the high-flow channel is controlled with a concrete weir. When high flows subside and the waterline of the sediment pond drops below the concrete weir elevation, flow to the high-flow channel is cut off entirely. This high-flow channel has attracted and, upon dewatering, trapped trout (Adolfson, 2000).

The lower section of the low-flow channel near the Cedar River has changed as a result of the loss of peak-flows. Although damaging floods are now directed to the armored bypass, less severe channel-forming events are also redirected, preventing the natural process of stream-channel maintenance and blockage removal during peak flow events. Beaver activity is common in the low-flow channel near the confluence with the Cedar River. Dams often block the main channel until maintenance officials remove them during flood events. Consequently, an overflow channel has developed that carries excess water from the beaver ponds west to a second confluence with the Cedar River (Figure 4).

The sediment pond has proven successful trapping sand and gravel from the upper drainage, but fine sediment continues to escape and deposit below the sediment pond. The fine sediment and low gradient have caused the beaver pond overflow channel to braid immediately upstream of its confluence with the Cedar River. These two factors, in combination with low flows and beaver activity in the lower reach, have buried habitat structures placed downstream of 149th Avenue SE (R. W. Beck, 1999). The beaver dams, sedimented channels, and debris accumulation in the low-flow channel block fish migration into the creek under most flow conditions. Some passage may be possible during medium flows, as evidenced by a coho carcass discovery above the sediment pond in 1997 (R. W. Beck, 1999) and by observation of migrating salmonids above the West Fork confluence in 1999 (Adolfson, 1999).

5.1.2 The Middle Reach

The riparian corridor within the middle and upper reaches is covered by deciduous forest dominated by red alder, black cottonwood, and big leaf maple, although some mature second growth western red cedar is found along the slopes adjacent to the upper reach. Salmonberry, reed canarygrass, and blackberry are common in the understory.

The middle reach, which flows through a deep ravine, has a degraded riparian area, limited amount of in-stream large woody debris (LWD) and a lack of deep, complex pools. Substrates are composed mainly of gravel and cobbles, with sand and occasional boulders. Morphology is generally a series of pools and riffles with some step-runs and cascades. Much of the fish habitat

appears unstable because of the erosion initiated by changes in stream flow from upstream development. This condition is exacerbated by a lack of LWD and poor riparian conditions.

5.1.3 The Upper Reach

The upper reach is almost entirely confined by the banks of the ravine. Habitat within the upper reach is generally a series of step-pools and cascades. Some LWD was placed in the upper section of the stream by King County in 1993 as mitigation for the high-flow bypass construction. Upper reaches, especially those encompassing the mitigation segments, are likely sources of sediment in the stream (R. W. Beck, 1999). Substrates are composed mainly of gravel and cobbles, with sand and human-placed boulders. Recent erosion-caused sedimentation in the upper reach has caused most of the stream flow to enter the high-flow overflow pipe, even during low-flow periods. This has resulted in a reduction of base flow by about one-half to two-thirds in approximately 850 feet of the upper reach (R. W. Beck, 1999).

5.1.4 The Tributaries

The proposed actions would focus on stabilizing three of the tributaries that drain into the middle and upper reaches of Madsen Creek. No work is proposed on the lower reach as part of this project. Five tributaries, the Northwest, West, Southwest, South, and East Forks, contribute flow to the mainstem of Madsen Creek. In addition, the East Fork itself has two smaller tributaries: the East Tributary and the East Fork Wetland Overflow. The West, Northwest, East Fork wetland, and East Tributary (a portion of the East Fork basin) subbasins are 40.5, 57.5, 16.8, and 34.3 acres in size, respectively. In all cases, the lower portions of these basins have steep slopes typical of the middle reaches of the Madsen Creek basin.

Fish habitat in the tributaries has been severely degraded by slope failures and channel incision initiated by large changes in storm flows. Most of the tributaries investigated have steep gradients with shallow pools. Migration barriers to anadromous or migratory resident fish are numerous downstream of the project area, effectively blocking nearly all upstream migration opportunities, although brief windows of unrestricted migration access may occasionally be available during medium flows.

Erosion and slope failure threaten the stability of hillslopes and send sediment and debris torrents into the main stem of Madsen Creek. This material contributes to the destruction of the creek's habitat and fills in the lower streambed and detention facility, causing the stream to overflow.

Above the East Fork of Madsen Creek (on the north side) is a wetland system that, prior to development in the area, had no sustained natural surface outlet. Grading and logging in the area have apparently changed the characteristics of the area to increase flow to the wetland. The wetland now regularly overflows down the east slope of the mainstem of Madsen Creek and the north slope of the East Fork. These overflows have caused large bank failures along the East Fork, resulting in mobilization of large amounts of sediment and debris. These overtopping events occur approximately twice yearly.

The West, Northwest, and East Fork tributaries are typical examples of what occurs when flow regimes are altered and the natural channel structures break down. Scars up to 40 feet deep mar

these ravines; vertical incisions five feet wide and 15 feet deep are typical. Portions of the ravines are inaccessible on foot due to high stair-step cuts along their channels.

5.1.4.1 *Stream Structure in the Tributaries*

The stream structure for these small tributary streams (particularly the West Tributary and East Fork) is typically held together by jams of small branches and roots. Stream substrates are generally unconsolidated, heterogeneous, non-cohesive materials, dominated by gravel (0.5 – 2.5 inches in diameter). The substrates also consist of small amounts of boulders (10 - 15 inches in diameter), cobble (2.5 – 10 inches in diameter), and sand (less than 0.1 inch in diameter). The substrate of the Northwest Tributary channel is mostly silty sand.

There is some LWD within the tributary ravines, but most of it is not in contact with the streams. Because of their large size in comparison to the stream channel width, logs have often remained in place while the stream has cut beneath them, leaving them suspended above all but the highest flows.

5.1.4.2 *Potential Fish Habitat in the Tributaries*

All the tributaries are characterized by steep riffles or step-pools with shallow, low-quality pool habitat. The Northwest and West tributaries have two distinct reaches based on grade. The upper reaches on both approach a 50 percent grade; the lower reaches drop to approximately four percent. The greatest incisions have occurred on the upper reaches, some approaching 30 feet. In the lower reaches, the stream has cut narrow channels with incisions of up to five feet.

Fish habitat in the Northwest, West, and East Tributaries, and in the East Fork consist of small, shallow pools with limited cover, interspersed between steep drops (step-pools). Only the East Fork and the lower portion of the West Tributary have areas that appear potentially suitable for fish (i.e., pools with suitable depth and cover). Steelhead and cutthroat trout may use the East Fork; however, coho, sockeye, and chinook salmon are unlikely to be found here. It is unlikely that any of these five species of salmonids are found in the Northwest, West, or East tributaries of Madsen Creek. The steep gradients, shallow depth, small pools, limited in-stream cover, and silty substrate of the Northwest Tributary limit both fish and invertebrate habitat. The West Tributary may have historically supported fish in the lower reaches; however, the small, shallow pools and steep gradient probably do not currently support fish. Fish usage in the West Tributary is further inhibited by low base flow—less than 0.03 cubic foot per second. The East Tributary above the East Fork has similar limiting factors for fish—a steep gradient and shallow, small pools that provide little area for rearing or refuge. All tributaries potentially provide habitat for salmon and trout prey species (aquatic insects) although that potential is very limited in the Northwest Tributary.

5.1.5 Properly Function Conditions in Madsen Creek

5.1.5.1 Water Quality

Madsen Creek is classified as a Class AA waterbody by the Washington Department of Ecology (Ecology), supporting beneficial uses such as fish habitat, aesthetics, and wildlife. From the limited information available, the following water quality concerns have been identified:

- Erosion induced turbidity, sediment, and organic debris.
- Temperature increases from vegetation losses due to erosion.
- Release of untreated wastewater caused by sewer pipeline damage due to erosion and high storm flows.
- Residential runoff containing fertilizers, pesticides, household chemicals, and pet wastes.
- Roadway runoff containing oils, grease, and metals.
- Golf course runoff and seepage containing pesticides and fertilizers.

The release of untreated wastewater due to damage of the sewer pipeline has occurred only once in 30 years. This potential will be eliminated if the sewer line were rerouted out of the Madsen Creek ravine. Rerouting is currently being explored, and if approved, would be completed within four to five years. Currently, it appears that the largest water quality concerns arise from high levels of turbidity, excess sediment loads, and loss of protective vegetative cover, all associated with the erosional impacts of excessive stormflows. Erosion-producing storm events can occur up to several times each winter.

Complete, up-to-date information on water quality in the Madsen Creek basin is not available for the various pathways and indicators related to water quality that are typically measured in a properly functioning conditions (PFC) assessment. Some test results, however, have been compiled from sampling done in the action area. A summary of existing information on Madsen Creek water quality was provided in the 1999 report, *Madsen Creek Pipeline Protection and Stream Restoration Project* (R.W. Beck, February, 1999).

Data collected in 1990-1991 in the Madsen Creek basin show some indications (in addition to excessive turbidity and sediment) of elevated phosphorous, fecal coliform bacteria, copper, lead, and zinc levels (R.W. Beck, 1999). One sediment sample, taken from an upland basin channel, showed high levels of the pesticide 2,4-D. All of these constituents are indicators of contamination from one or more of the sources listed above and can negatively impact aquatic life, including sensitive fish species.

Water quality in Puget Sound lowland streams is not often a limiting factor (May et al., 1997). Given the presence of resident fish within the project area (Johnson, personal communication, 1999), it is unlikely that there are acute water quality problems in Madsen Creek. It is likely, however, that Madsen Creek is at risk regarding chemical contaminants and nutrients given the development of the upstream basin (suburban residential development, golf course, and

extensive road systems). It is unknown if there are significant chronic water quality stresses within the system in regards to temperature. Erosion and sediment in the project area have been a documented concern and it is assumed that Madsen Creek is not properly functioning regarding sedimentation.

5.1.5.2 Habitat Access

The sediment pond outlet in the middle reach, and culverts, beaver dams and vegetation in the lower reach are known to be partial barriers to fish passage. Spawning surveys, however, have found coho carcasses upstream of the sediment pond indicating that anadromous fish may not be totally blocked from accessing parts of the project area. The sediment pond and downstream barriers appear to primarily block upstream fish migration during low-flow and high-flow periods. It appears that Madsen Creek is at least at risk, and may not be properly functioning, regarding physical barriers in the watershed.

5.1.5.3 Habitat Elements

The condition of habitat elements in Madsen Creek is well documented in the predesign report. Scour, bank erosion, and sedimentation have resulted in an improperly functioning condition for most elements of in-stream habitat including LWD, pool frequency, pool quality, and refugia. Although substrates are highly embedded in areas, some sections of stream appear to still provide some function as spawning habitat and as habitat for in-stream benthic invertebrates, which are important prey species for fish. It is likely that substrate conditions are at least at risk and may be not properly functioning. The restoration of in-stream habitat is a primary goal of the projects and the proposed actions are anticipated to result in the restoration of most in-stream habitat elements, particularly relating to pool frequency, pool quality, and LWD.

5.1.5.4 Channel Condition and Dynamics

Channel conditions in Madsen Creek have been degraded by increased in-stream flows resulting from development and documented slope stability concerns in the ravine. The width/depth ratio of the stream is at risk. Stream bank conditions are not properly functioning as documented in the predesign report. Floodplain connectivity is limited by ditching in the lower reach downstream of the project area and by SR-169, which bisects the southern portion of the Cedar River floodplain and crosses Madsen Creek. Floodplain connectivity is also limited by degraded habitat conditions in the middle reach upstream of the sediment pond. For these reasons, floodplain connectivity likely ranges from at risk to not properly functioning in Madsen Creek. It is anticipated that habitat improvements and channel stabilization efforts will restore some level of functionality to this system.

5.1.5.5 Flow/Hydrology

On an average of every two years, floods occur in the Madsen Creek system that exceed the pre-development 100-year flood event by four to 60 percent. These peak flows have resulted in

excessive scour within the stream channel in the upper reaches during storm events. Additionally, base flow in Madsen Creek may be limited as a result of development in the upper basin, and high flows in the low-flow channel are limited by the high-flow bypass inlet structures in the detention pond. As a result, peak flow/base flow in Madsen Creek is not likely functioning properly.

The project is anticipated to correct these flow issues to some extent through detention, although the amount of detention capacity necessary to return flows in the basin to pre-development levels is currently unavailable. The project will likely improve flow conditions in some parts of the system to at least an at-risk condition. Exact results depend on the efficacy of the proposed action, and the amount of effort that is directed towards the adjustment of installed structures in the five-year period following completion of the project.

Logging, development, and the construction of a large road system cutting across the upper and lower portions of the drainage have degraded the condition of the Madsen Creek watershed. Although disturbances in the ravine and upper Madsen Creek have been significant, resulting in an at risk condition, development in the upper basin has slowed and logging or significant clearing in the ravine has not occurred for decades. The project will have little impact on these larger watershed issues and these conditions are anticipated to be maintained within the foreseeable future.

5.2 The Cedar River

Historic channel morphology and flow patterns of the Cedar River have been greatly altered during the past hundred years as a result of channelization, flood control efforts, and dam construction and water withdrawals by Seattle Public Utilities (SPU), which manages the upper Cedar River watershed as a municipal water supply. The Cedar River is almost entirely disconnected from its historical floodplain within the project area, and naturally occurring large wood is entirely absent. These alterations contribute to the absence of side channels that provide rearing and winter refuge habitat for juvenile salmonids, and large holding pools for migrating and spawning adult salmon.

Nonetheless, chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*O. kisutch*), and native char (including bull trout, *Salvelinus confluentus* and Dolly Varden, *S. malma*) are currently present, or suitable habitat for them at some stage in their life history is currently present, in the Cedar River. Specifically, spawning and rearing habitat for chinook and coho salmon is available in the Cedar River, and some suitable habitat for foraging native char is potentially present, although there is little recorded use of the river by the genus *Salvelinus*.

The King County Department of Transportation Roads Services Division (KC Roads) proposes to replace the Elliott Bridge, which spans the Cedar River at approximately river mile (RM) 5.2.

A report on the project titled *Existing Fish Habitat Conditions in the Lower Cedar River* (KCDNR, 2000) summarizes the results of a fish habitat survey conducted the lower Cedar River, beginning at the Landsburg Dam (RM 21.4) and extending downstream to RM 1.0, approximately four miles downstream of Madsen Creek. The survey included an evaluation of fish habitat distribution, channel morphology, substrate composition, floodplain connectivity,

riparian land-use and vegetation, and current and potential use of the project area by listed, proposed, and candidate fish species protected under the federal Endangered Species Act. A summary of the report and observations by Adolfson biologists is provided in Appendix C. Cedar River pathways and indicators are summarized in Table A-1 (Appendix A).

6.0 STATUS OF THE SPECIES AND CRITICAL HABITAT

6.1 Puget Sound ESU Chinook Salmon (*Oncorhynchus tshawytscha*)

Chinook salmon have a historic range from the Ventura River in California to Point Hope, Alaska in North America; and from Hokkaido, Japan to Anadyr River in Russia (Meyers, et al., 1998). Chinook salmon in Madsen Creek are included in the Puget Sound Chinook ESU, a population currently listed as threatened under the ESA in Washington State.

6.1.1 Critical Habitat

Critical Habitat has been designated for Puget Sound ESU chinook salmon and includes all waterways historically accessible to chinook. The Cedar River, as well as historically accessible sections of the Madsen Creek, are both part of this designated area (Federal Register 50 CFR, Part 2260).

6.1.2 Life History

Chinook require varied habitats during different phases of their life. Spawning habitat typically consists of riffles and the tailouts of pools with clean substrates dominated by cobbles. These habitats are located in the mainstem of rivers and large tributaries. Juvenile chinook rear in the lower mainstem of rivers and tributaries before entering the estuary and salt marshes (Meyer et al., 1998). Adult chinook salmon spawn in freshwater streams in the late summer and fall. Fry emerge in the late winter and early spring. Juvenile chinook may rear in freshwater from three months to two years (NMFS, 1998), although most Lake Washington chinook migrate to salt water the following spring and summer (Meyer et al., 1998; Pfeiffer, 1999; Wydoski and Whitney, 1979). The exact percentage of chinook juveniles that remain in the Lake Washington basin beyond the first summer is not clear, although recent evidence indicates it may be higher than previous estimates of one percent (Fuerstenberg, 2000). Most chinook spend from two to four years feeding in the North Pacific before returning to spawn. Chinook salmon die after spawning.

6.1.3 Environmental Baseline

The highest level of wild chinook spawning in the Lake Washington basin occurs in the Cedar River and Bear Creek drainages (Williams et al., 1975; WDFW, 1994; Carrasco, et al., 1999). In the Cedar River, chinook return in the late summer and early fall to spawn in the mainstem from mid-September through October as far upstream as the Landburg Dam (RM 21.4), although the

heaviest spawning has historically been concentrated between RM 5 and RM 15 (WDF, 1975). Stock origin in the Cedar River is native, and reproduction is wild (WDFW, 1994). Escapement data show a range of returns to the Cedar River in the late summer and early fall ranging from approximately 241 to 1,800 adults (WDFW, 1994; King County DNR, unpublished information, 2001). The Muckleshoot Tribe believes that this stock is best described as depressed (WDFW, 1994), mainly due to a severe decline in escapement over the last few years (1996 to 2000). Only 241 adult chinook returned to the Cedar River to spawn in 1999. Data from Cedar River surveys conducted in 2000 indicate 140 adults returned in 2000 through the month of December; both totals are well below the hypothesized thresholds (500 to 5,000) for significant genetic and demographic risks to small populations.

Although chinook adults are not known or thought to use Madsen Creek for spawning or foraging (Washington Department of Fisheries, 1975; Fisher, personal communication, 1999), it is possible that a portion of the one percent of rearing Cedar River chinook that remain in freshwater past the first spring and early summer may seek refuge in the mouth of Madsen Creek from high temperatures in the late summer. Since the terminus of the project area is approximately one mile upstream from the mouth of Madsen Creek, the potential of juvenile use in work areas is likely discountable.

6.2 Bald Eagle (*Haliaeetus leucocephalus*)

The bald eagle is federally listed as threatened in Washington State. Bald eagle populations in Washington have recently been proposed for delisting by USFWS; however, the publication of a final delisting rule, if determined by USFWS to be warranted, is not likely to occur prior to project implementation.

6.2.1 Critical Habitat

No Critical Habitat has been designated or proposed for bald eagles.

6.2.2 Life History

Bald eagles are both residents in, and migrants through, King County. Eagle populations are usually highest in the Puget Sound region in January, when birds that had moved north in late summer to feed on coho salmon runs in British Columbia and Alaska return to winter in the region (Matthews, 1988). In western Washington, bald eagles breed during mid- to late winter. Bald eagles typically return to one of several nests located within an established nesting territory (Matthews, 1988; Stalmaster, 1978). Eggs laid in March and April hatch within one and a half months. Young eagles hatched in June will generally fledge in mid-summer (September). As bald eagles are primarily fish eaters, they usually nest within one mile of open water. Their home range generally extends up to eight miles from the nest (Muller, personal communication, 1994).

Bald eagles generally perch, roost, and build nests in mature trees near water bodies and available prey. Bald eagles usually spot prey while perching or soaring (Ehrlich et al., 1988).

Stalmaster (1987) reports that typically over 50 percent of an eagle's diet comes from fish, 25 percent from other birds, and 15 percent from mammals, although they will also feed on carrion (Stokes and Stokes, 1989; Matthews, 1988).

6.2.3 Environmental Baseline

The occurrence of bald eagles in central Puget Sound has been documented since pre-settlement times. Eagle populations have decreased within the region as a result of hunting (legal until the 1940's) and the widespread use of DDT. Since DDT was banned in 1972, bald eagle numbers have been increasing in the region. The rivers and numerous lakes in the Puget Sound lowlands provide habitat for both nesting and wintering bald eagles.

Although no nests or roosts are known to exist within one mile of the project boundaries, waterfowl are known to congregate in a group of small, lowland lakes located approximately one mile to the southeast. The Cedar River, located approximately 1,000 feet north of the northernmost staging area, also attracts bald eagle during the fall salmon runs. Perching eagles have been observed perching along the Cedar River approximately 0.25 miles downstream of the lower Madsen Creek confluence (0.5 miles from the northernmost staging area). This perch site is within the recommended buffer of one mile for construction activity (USFWS, 1999b), but is well screened by other trees from the northern staging area.

6.3 Coastal Bull Trout (*Salvelinus confluentus*)

The historical distribution of bull trout extends from northern California to Alaska. In Washington, bull trout are found throughout coastal and inland streams and lakes (WDW, 1991). Bull trout in the Lake Washington basin are considered coastal bull trout. This population has been listed by USFWS as threatened.

6.3.1 Critical Habitat

Designation of Critical Habitat for bull trout has been determined to be "unwarranted" by the USFWS.

6.3.2 Life History

Bull trout have a complex life history that includes a resident form and a migratory form. The individuals of the migratory form may be stream dwelling (fluvial), lake-dwelling (adfluvial), or ocean- or estuarine-dwelling (anadromous) (USFWS, 1998). Individuals of each form may be represented in a single population; however, migratory populations may dominate where migration corridors and subadult rearing habitats are in good condition (USFWS, 1998). Most inland populations of bull trout are either fluvial or adfluvial, migrating from larger rivers and lakes to spawn in smaller tributary streams in September through October (Wydoski and Whitney, 1979). Bull trout spawn in streams with clean gravel substrates and cold (less than nine degrees Celsius/ 48 degrees Fahrenheit) water temperatures (USFWS, 1998). Spawn timing is relatively short, spanning from late October through early November. Redds are dug by

females in water eight to 24 inches deep, in substrate gravels 0.2 to 2 inches in diameter (Wydoski and Whitney, 1979). Emergence generally occurs in the spring. Bull trout are opportunistic feeders, consuming fish in the water column and insects on the bottom (WDFW, 1991).

6.3.3 Environmental Baseline

Low stream temperatures and clean substrates are key features of bull trout habitat. This species is most commonly associated with pristine or only slightly disturbed basins (USFWS, 1998). The *Bull Trout and Dolly Varden Appendix to the 1998 Salmonid Stock Inventory* (WDFW, 1998) states that reproducing populations of bull trout and Dolly Varden within the Lake Washington Basin are limited to the upper Cedar River basin in Chester Morse Lake (WDFW, 1998). Bull trout and Dolly Varden occurrence elsewhere in the Lake Washington drainage basin is rare. The adfluvial population in Chester Morse Lake is a glacial relict separated from stocks in the Snohomish River system when the outlet of Chester Morse Lake was diverted south during the last glacial period (WDFW, 1998). The waterfall that resulted at the outlet of the lake, known as Cedar Falls, is a blockage to anadromous populations.

Even though reproducing bull trout populations have not been documented in the Cedar River below Chester Morse Lake (WDFW, 1998), (sub) adult fluvial bull trout may enter Lake Washington and the Cedar River from other basins to forage. The extent of use by bull trout in the Cedar River is unknown, but expected to be rare. Only 10 bull trout/Dolly Varden individuals have been observed and documented in Lake Washington/Cedar River drainage in the last 20 years (WDFW, 1998). Three of these observations were made in the Cedar River delta (near the Lake Washington confluence) in the mid-1980s. Only one bull trout has been documented above the Cedar River Delta—between Cedar Falls and the Landburg dam. Currently, the Cedar River mainstem is considered to be an “intermittent use zone” for bull trout (USFWS, 2000).

No bull trout/Dolly Varden have been documented in Madsen Creek or within the action area. Bull trout do not typically use streams with temperatures above 48 degrees Fahrenheit. Madsen Creek does not appear to provide suitable habitat for bull trout due to the likelihood of water temperatures above 48 degrees as well as chronically high levels of scouring and sedimentation in the stream. Although access to the project site is generally blocked by debris jams during low-flow periods prior to fall freshets, no physical factors are known to be present that would absolutely preclude bull trout from Madsen Creek. The likely presence of bull trout in the project area, however, is estimated to be discountable due to the rarity of the species in the watershed and lack of suitable bull trout habitat in the Madsen Creek drainage. The likely presence of bull trout in the Cedar River portion of the action area, although unlikely, is not discountable. Potential effects of the proposed actions on the Cedar River are discussed in section 7.0, “Effects of the Action.”

6.4 Puget Sound/Straight of Georgia ESU Coho Salmon (*Oncorhynchus kisutch*)

Coho salmon are currently a candidate fish stock. No protection for candidate stocks is afforded under the ESA, and section 7 consultation or conference with NMFS is not required for anticipated impacts to these species. Summary information for this candidate species is included herein in the event these candidate species become listed or proposed prior to project completion.

6.4.1 Critical Habitat

No Critical Habitat has been identified or proposed for coho salmon.

6.4.2 Life History

Coho salmon are anadromous, and occur in most major river basins around the Pacific Rim from central California to Korea and northern Hokkaido, Japan (Weitkamp et al., 1995). Adult coho salmon spawn in freshwater streams in the late fall and early winter. Coho typically spawn in low gradient riffles with clean substrates ranging from pea-sized gravels to orange-sized cobbles (Henry, 1995). Rearing juveniles prefer off-channel pools with complex cover including both large and small woody debris (Henry, 1995). Juvenile coho rear in freshwater for a year to 18 months. Smolts migrate to the ocean in the spring of their second year. Most male coho, and all female coho, spend from 16 to 20 months rearing in the ocean and return to spawn in fresh water as three-year old adults. The spawner distribution of the Lake Washington coho salmon stock includes Madsen Creek (WDFW, 1994).

6.4.3 Environmental Baseline

Coho are known to occur in the Lake Washington Basin including the Cedar River system. Coho salmon stocks in the Cedar River have been identified as "healthy" based on escapement levels (WDFW, 1994). Coho and sockeye use has been documented in the project area (Williams et al., 1975, WDFW, 1994, WDFW, 2000) and Madsen Creek appears to support limited spawning and rearing habitat for coho. Juvenile coho may rear in fresh water systems for up to three years. It is likely that some rearing juvenile coho will be present within the lower elevation portions of the project area, including dewatered sections, during project construction. Tributaries are usually dry between June 15 and September 15 when in-water work is allowed, and coho presence in these areas of the project is therefore unlikely during in-water work. It is assumed, however, that during the in-water work window, juvenile coho in the Madsen Creek system are capable of accessing the middle and parts of the upper reaches of Madsen Creek, and that juvenile coho are potentially present in all mainstem work areas.

7.0 EFFECTS OF THE ACTION

Based on:

- 1) documentation of fish use downstream of the proposed work areas;